Space Weather Technical Forecast

Issued on Tuesday, 13 August 2024 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1-G2/Minor to Moderate geomagnetic storms likely day 1 (13 Aug) and possibly day 2 (14 Aug) with ongoing CME arrivals. Further M-class flares expected with a slight chance of isolated X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with just two low level M-class flares observed in the past 24 hours, originating from AR3777 and AR3784. There are nine sunspot regions visible on the disc. AR3780 situated in the southwest remains the largest region, displaying a complex magnetic structure with at least two weak delta spots, one to the north of the main spot and the other within penumbra to the south. AR3784 in the northeast is large and complex, with a somewhat unusual delta spot configuration, now with gamma complexity, showing some areal increase to the trailing potion. AR3777 near the southwest limb is difficult to analyse due to foreshortening. All other spots are small and simple.
No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parameters at L1 by DSCOVR/ACE were already showing a previous CME arrival and were indicative of at least one further CME arrival during the period. Solar wind speeds have eased from elevated 510 km/s to slightly elevated around 460 km/s. Density was above average for much of the period dipping back to average between 12/1400-1900 UTC. 50ppcc was observed around 12/0122UTC. The Interplanetary Magnetic Field, Bt, was generally moderate to strong, peaking at 23nT at 12/0100UTC. The north-south component, Bz, was mostly negative, falling to -20nT at times. Phi angle fluctuated but ended the period predominantly negative (towards the Sun). Geomagnetic activity was at G1/Minor Storm (Kp 5) to G4/Severe storm (Kp8) levels.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 were predominantly at background levels. The 24-hour fluence was steady and well below the Active threshold, with 1.01e6 integrated pfu observed at 13/0000 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast, with further M-class flares expected and a slight chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: Ongoing CME impacts are expected to wane during day 1 (13 Aug) before the possible arrival of up to two glancing CMEs, with speeds becoming elevated again. No further enhancements are currently expected days 3 (15 Aug) and 4 (16 Aug) with speeds gradually declining back to slightly elevated or background.
Geomagnetic activity is expected to fall from current G1/Minor storm or G2/Moderate Storm (Kp 5-6) levels to Active before the possible arrival of up to two glancing CMEs during day 1, with further occasional G1-G2/Minor to Moderate Storming (Kp 5-6) intervals likely and a slight chance of a further G3/Strong Storm (Kp 7) interval. This risk decreases going into days 2, 3 and 4 (14-16 Aug), with activity expected to decline towards Quiet to Unsettled levels (Kp 2-3).

Energetic Particles / Solar Radiation: A heightened risk of flare activity brings the slight chance of reaching/exceeding the S1 Minor Radiation storm level should any significant flares occur from active regions in the western hemisphere. The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

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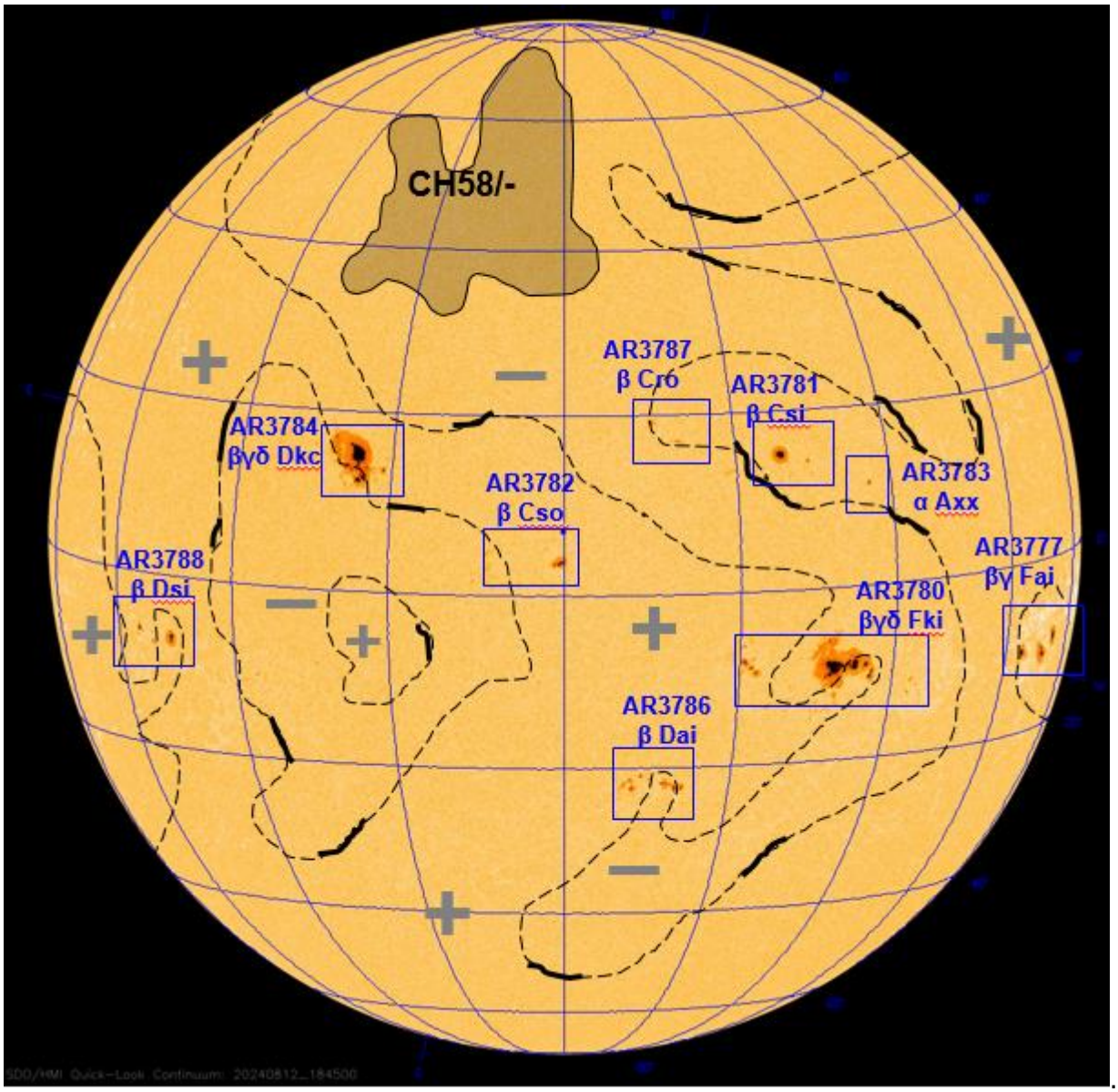
Figure 1. Solar Analysis Valid 12/1900UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Ongoing influence from a CME from 08 Aug is expected to continue to wane in coming hours. Another CME in association with the M4.5 flare from AR3777 at 09/2123 UTC produced a partial halo CME alongside a Type II radio emission (estimated velocity 600km/s). This is forecast to have an Earth-directed component, with analysis suggesting an arrival early on day 1 (13 Aug). This arrival may be coincident with a further partial halo CME which was observed in association with the M5.3 flare from AR3780 at 10/0237UTC. The interaction of these two CMEs acting to lower confidence.

Overall it is likely there will be continued CME influence through days 1 and 2 (12-13 Aug) with activity expected to decline day 3 (14 Aug) onwards with no other enhancements currently expected. Overall confidence in the forecast is low however.

Geomagnetic activity is expected to fall from current G2/Moderate Storm (Kp 6) levels to Active or G1/Minor storm levels before the possible arrival of up to two glancing CMEs later day 1 or day 2, with further occasional G1-G2/Minor to Moderate Storming (Kp 5-6) intervals likely and a slight chance of a further G3/Strong Storm (Kp 7) interval. This risk decreases going into days 3 and 4 (14-15 Aug), with activity expected to decline towards Quiet to Unsettled levels (Kp 2-3).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	90	50	20	20
Strong	G3	Yes	20	15	1	1
Severe	G4	Yes	10	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/2123	Partial	M4.5 flare	AR3777	633 km/s	13/0300UTC +8hrs	Low confidence combined arrival
10/0645	Partial	M5.3 flare	AR3780	750 km/s	13/0300UTC +8hrs	Low confidence combined arrival

Figure 2: Estimated Planetary K index (Kp)

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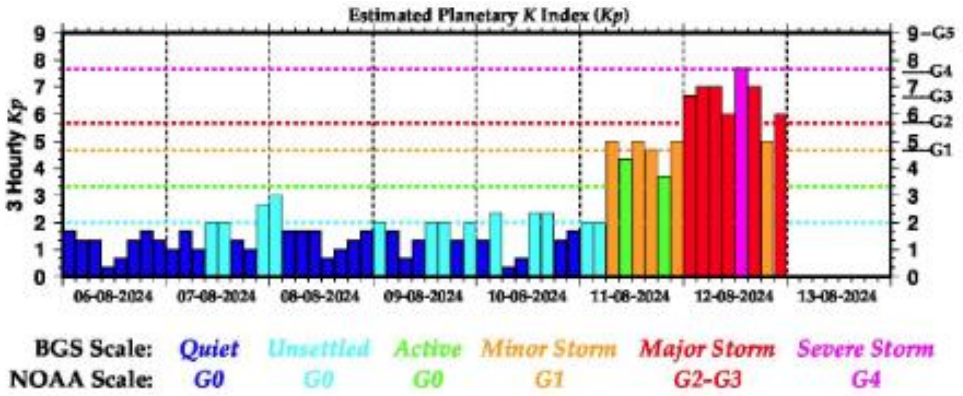

Estimated Planetary K Index (Kp)
3 Hourly Kp
9 8 7 6 5 4 3 2 1 0
9 G5 8 G4 7 G3 6 G2 5 G1 4 3 2 1 0
06-08-2024 07-08-2024 08-08-2024 09-08-2024 10-08-2024 11-08-2024 12-08-2024 13-08-2024
BGS Scale: Quiet Unsettled Active Minor Storm Major Storm Severe Storm
NOAA Scale: G0 G0 G0 G1 G2-G3 G4

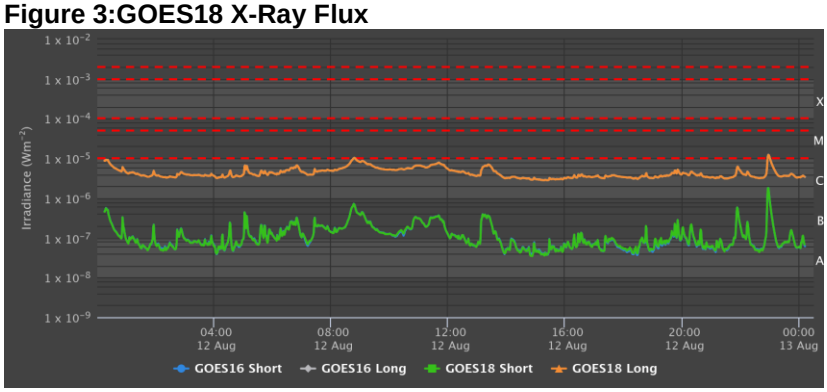
Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate with two low level M-class flares observed in the past 24 hours, one originating from AR3777 the other AR3784.
There are nine sunspot regions visible on the disc. AR3780 situated in the southwest remains the largest region, displaying a complex magnetic structure with at least two weak delta spots, one to the north of the main spot and the other within penumbra to the south. AR3784 in the northeast is large and complex, with a somewhat unusual delta spot configuration, now with gamma complexity, showing some areal increase to the trailing potion. AR3777 near the southwest limb is difficult to analyse due to foreshortening. All other spots are small and simple.

Further M-class flares are expected with a chance of an isolated X-class flare, these perhaps most likely from AR3780. The only significant spot to rotate off the disk during the period is AR3777 by the end of day 2 with a slightly reduced flare probability thereafter.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3:GOES18 X-Ray Flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, was at background throughout the period. Any strong flares will bring the slight chance of reaching/exceeding the S1 Minor Radiation storm level. Initially the risk mainly from AR3774 and AR3777 currently in the western hemisphere, but increasingly from AR3780 as it rotates into the western hemisphere later in the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

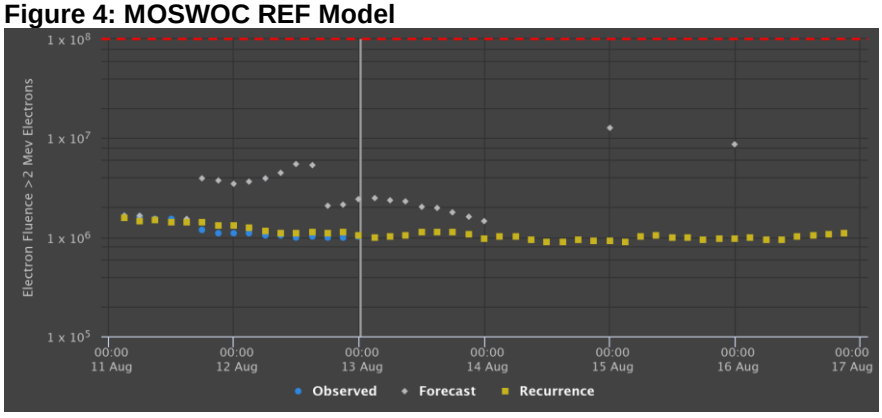
High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at background with the likelihood of further geomagnetic activity early in the period expected to keep observed values generally suppressed near background level. This is lower confidence however and any significant geomagnetic storming could also see electron flux at GEO increase to moderate or even high levels given the potential for electron transfer from currently more highly changed regions below GEO.

The associated 24hr electron fluence is therefore currently expected to remain below Active (1e8 integrated pfu) levels throughout but with reducing confidence into the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	15
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REF Model



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